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Wind Power Systems and The Air Force

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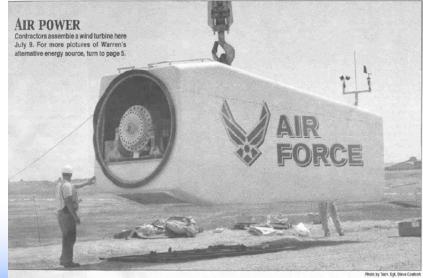
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May 2005

Wind and the Air Force - An Oxymoron?

- DOD is the single largest energy user in the USA
- This presents opportunity
- Executive Order 13123 requires energy efficiency and establishing renewable energy Goals
- The new requirements of the energy bill! Oh Boy!
- Can they co-exist, wind turbines and the Air Force?
 - Yes they can
 - They are, in remote locations
 - Now in Wyoming
 - FE Warren AFB
 - 2 Vestas 660 kW turbines
 - Navy using Turbines in
 - Guantanamo Bay
 - San Clemente





Air Force ECIP Activities

An active energy conservation and investment program (ECIP)

- Ongoing or completed projects
 - Ascension Phase 1
 - Ascension Solar System
 - Ascension Phase 2
 - Grassmere Solar System
 - FE Warren Phase 1
 - Multiple Small Systems
- Potential Sites
 - Alaska Sites
 - Guam
 - Hawaii/Kaena Point
 - FE Warren, Phase 2
 - More to come





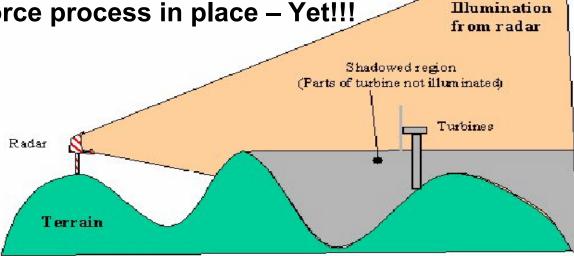
Ongoing Activities

- DOD renewable energy assessment report completed March, 2005
 - Included wind data collection
 - Identified potential wind resources on or near DOD facilities
 - Identified green energy procurement strategies
 - Identified a need for renewable energy on bases to enhance national security and reduce energy costs
 - Assessed all renewable energy systems, including wind
 - Provides an awareness, and a plan for future activities
 - Available on DOD web site



Ongoing Activities, cont.

- Wind Radar
 - Mission and Radar system impacts a valid concern
 - NTS project cancelled due to mission impact
 - Multiple radar interference impacts on UK projects
 - FAA has concerns when close to their radar systems
 - IEA hosted wind radar conference March, 2005
 - No DOD/Air Force process in place Yet!!!

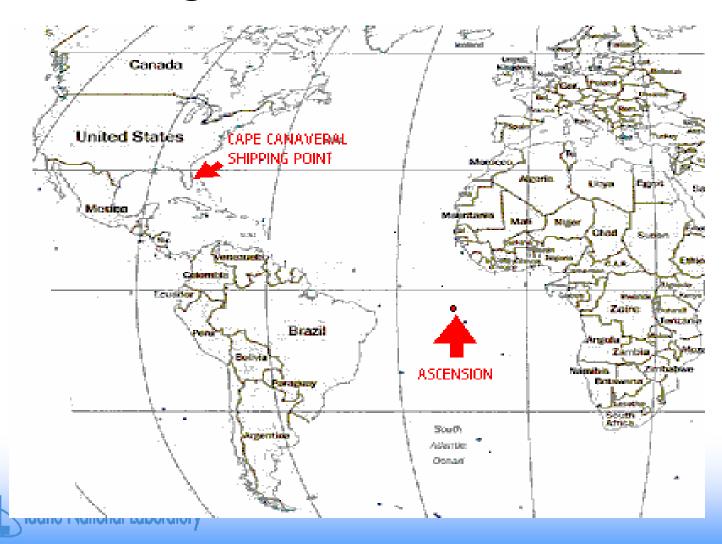




Background information Ascension



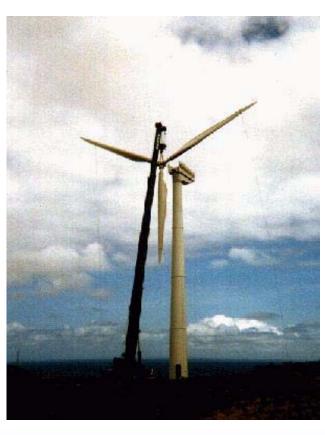
Background information



Background information



Remote Challenges - Examples



- Remote shipping 5000 miles from Port Canaveral
- Restricted shipping schedules
- Pier restrictions
- Limited crane reach
 - –Very short towers
- Limited island access



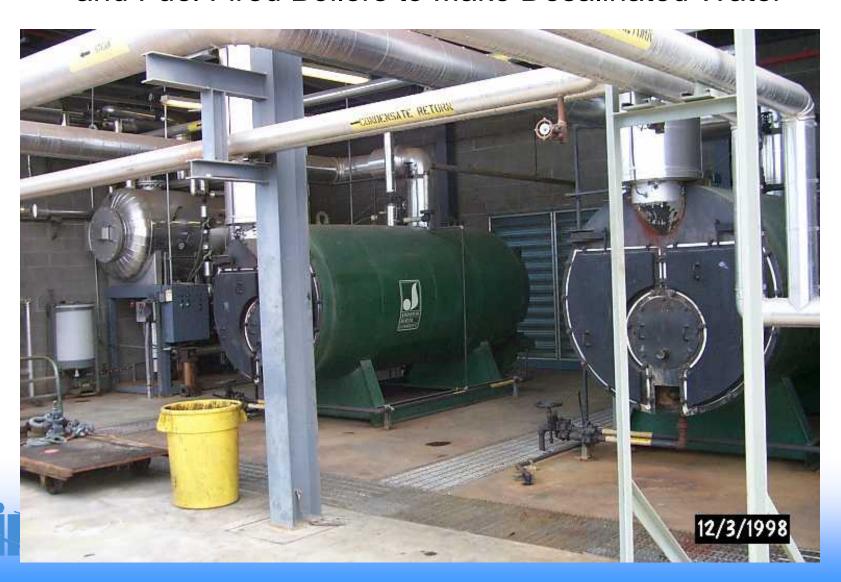
Example Project - Ascension

Before, Diesels and



Example Projects - Ascension

--- and Fuel Fired Boilers to Make Desalinated Water



Long History of Wind On Ascension From Humble Beginnings to



Wind farm at Ascension



Phase 2

Phase 1





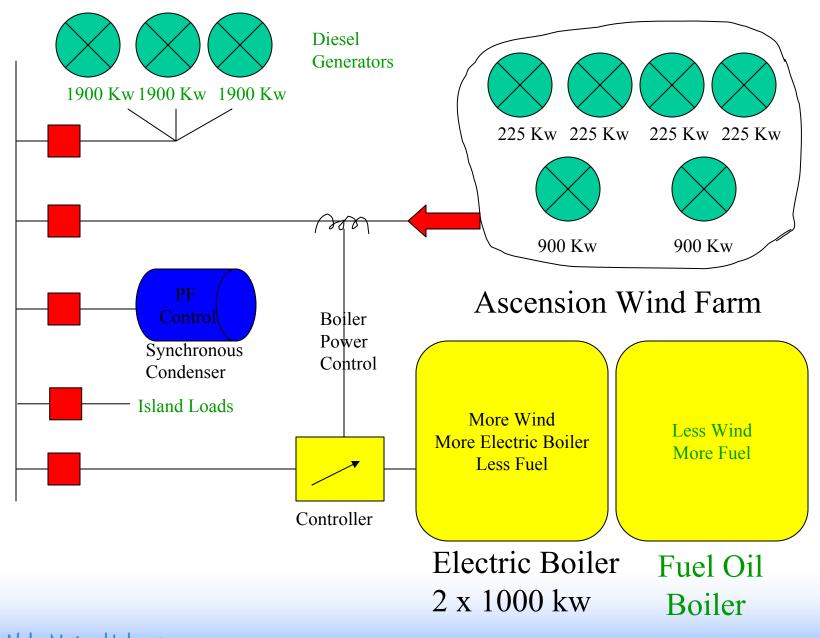
High Penetration Design

Synchronous Condenser

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(VAR support and Rotating Mass)

- 2 each (1 MW) electric boilers designed for;
 - steady state average load,
 - control variability fine tuning
 - automated load/generation leveling
 - boiler controls monitor wind farm output
 - manage boiler load to wind farm output
 - Keep Penetration low (by adding load)

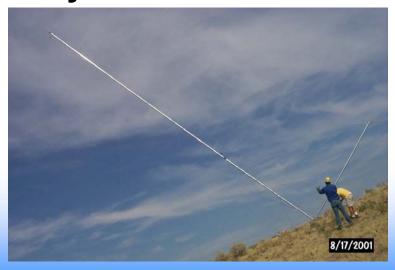


Ascension Wind Diesel Hybrid System

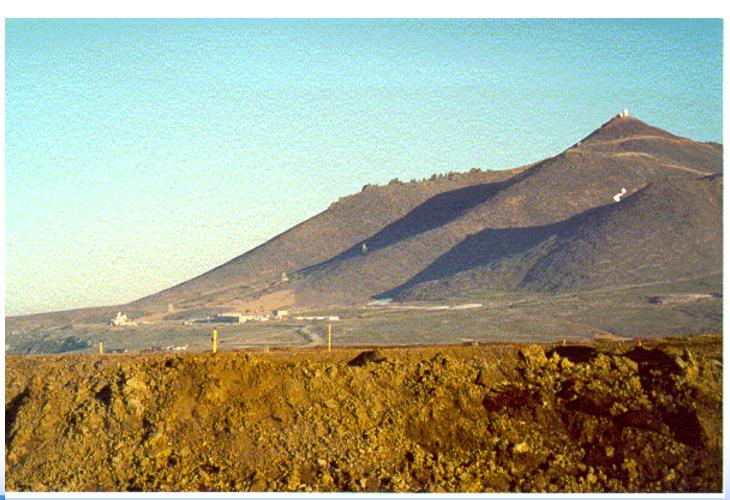
From Humble Beginnings

- All projects start small
- Assess the resources
 - Use anemometers
 - Military weather data
 - Be careful, runway data?
 - Runways not always windy
- Assess the costs
- Does it make sense
- Mission Impact?
- Source of funding?





Tin City LRR, Alaska



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Tin City Wind Summary

ESTIMATED ENERGY PRODUCTION

Date Range 2003-09-10 TO 2004-06-27 **SITE 7011**

Site Information

Project: Alaska Air Force
Location: Tin City LRR
Site Elevation: 360FT
Averaging Time: 10 min

 Sensor 1 Information

 Channel:
 1

 Type:
 Anemometer

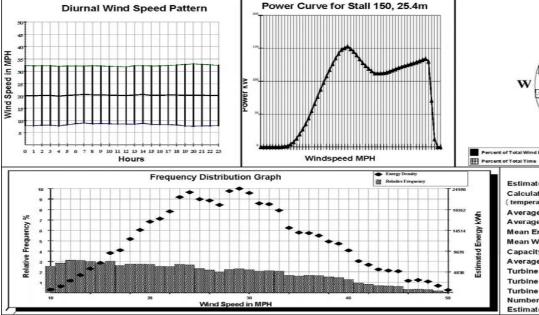
 Scale:
 1.223000000

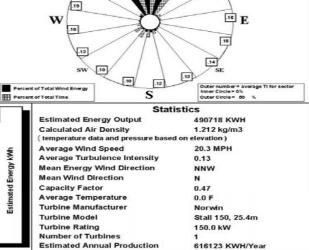
 Offset:
 1.8000

 Description:
 Anemometer

 Height:
 26FT

WIND ROSE GRAPH





Total hours = 7008 Total hours used in Calculations = 6977 Percent Data used = 99.5



Printed July 26, 2004

Cape Romanzof LRR, Alaska





Cape Romanzof Wind Summary

ESTIMATED ENERGY PRODUCTION

Date Range 2003-09-11 TO 2003-12-29

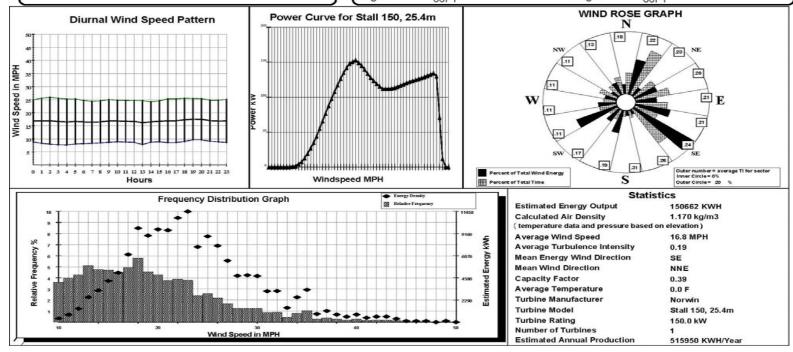
SITE 7012

Site Information

Project: Alaska Air Force
Location: Cape Romanzof LRR

Site Elevation: 1432FT Averaging Time: 10 min

Sensor 1 Information Sensor 2 Information Channel: Channel: Type: Type: Direction Vane Anemometer Scale: Scale: 1.223000000 1.000000000 Offset: Offset: 0.0000 1.8000 Description: Direction Vane Anemometer Height: Height: 66FT 66FT



Total hours = 2640 Total hours used in Calculations = 2558 Percent Data used = 96.8

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Annual Average Wind Speed Projections

Based on correlation with long-term data

- Tin City LRR: 18-19 mph @ 8-10 meters
- Cape Romanzof LRR: 15-16 mph @ 20 meters
- Andersen AFB, Guam: 13.5-14 mph @ 50 meters

Next, long term cost analysis and concept designs



F E Warren AFB – Another Success



- 2 x 660 kW turbines
- Averaging 500 kW an hour
- High Wind Speeds
- Restricted airspace
- Base power 2500-3000 kW
- Low cost Power
- 38-40% capacity factor
- 5-10% penetration, with no measurable impact



LESSONS LEARNED

- Perform resource assessments
- Know your mission, mitigate impact
- Partner at the beginning
- Performance based specifications
- Control system design and integration crucial
- Integrate load management into the control system for stability and high penetration
- Plan and model loads up front
- Wind/Diesel systems are very compatible
- You can have penetration above 25%, but plan and design for high penetration



Before







Wind – Air Force A great Team



After



Questions?

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